

February 16, 1875.

George Busk, Esq., F.R.S., V.P., in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of January 1875.

The total number of registered additions to the Society's Menagerie during the month of January was 75, of which 34 were by presentation, 33 by purchase, 1 by exchange, 2 by birth, and 5 were received on deposit. The total number of departures during the same period, by death and removals, was 74.

The most noticeable additions during the month of January were as follows:—

1. A Silver-backed Jackal (*Canis chama*, Smith), presented by Mr. H. B. N. Good on the 6th of January. Mr. Good informs me that he obtained the animal at the diamond-fields in Griqualand West, from a Dutch Boer, in November 1874. It had been caught near the Boer's farm some time previously; and Mr. Good has seen others of the same species in the same district.

This species of *Canis* appears to be very little known. It was described in 1835 by Sir Andrew Smith (South-African Quart. Journ. ii. p. 89*). 3

I have never seen a living example of this species before, and am only acquainted with the specimen in the British Museum, which is one of the types received from Sir A. Smith. It is remarkable for its large pointed ears, resembling those of the Fennec (*Canis cerdo*) and Syrian Fennec (*Canis famelicus*), of which we have also living specimens in the Gardens. It is also in other respects a strongly marked and very distinct species, as will be seen by the drawing (Plate XVII.) of the present specimen, made by Mr. Smit.

* This work is so very scarce that I think it may be useful to reprint the original description.

"*Canis chama*, Smith (The Asse). Muzzle, centre of face, and top of head yellowish brown, variegated by an intermixture of bristly hairs annulated black and white; sides of head a uniform whitish yellow; upper lip, towards angles of mouth, lower lip, and chin blackish brown; whiskers and edges of eyelids black; ears large, outer surfaces yellowish red, inner margined with white hairs, elsewhere bare. Woolly hairs of neck and body abundant, their tips reddish white or yellowish white, elsewhere a dull smoke-colour; bristly hairs abundant on back of neck and centre of back, on sides, shoulders, and outsides of thighs less numerous, all annulated black and white, the tips black. Extremities yellowish white, inclined to white on their anterior surfaces; a large brownish-black blotch on the posterior surface of each hinder extremity, about halfway between the feet and base of tail. Underparts of neck and body whitish yellow. Tail very bushy, the prevailing colour yellowish white, the upper surface towards base variegated with bristly hairs annulated black and white; the black, about three inches from the root, is so disposed as to give an appearance of one or two waved transverse black stripes; from thence to the point the bristly hairs are all tipped with black, and at the very extremity of the tail they are almost entirely of that colour, so that it appears perfectly black. Length, from nose to base of tail, 23 inches; length of tail 13 inches; height at shoulder 12 inches, at rump 13 inches.

Inhabits Namaqualand and the country on both sides of the Orange river.

Dr. Gray (who miswrites the specific name of this animal "*caama*"*) has given a figure of its skull.

2. A Banded Cotinga (*Cotinga cincta*) from Bahia, purchased Januáry 18, being, so far as I know, the first example of any species of this magnificent group of birds that has reached Europe alive.

3. An Australian Cassowary (*Casuarius australis*) from northern Queensland, presented by the Marquess of Normanby, F.Z.S., Governor of New Zealand, 23rd Januáry, being the specimen previously announced as having been sent off by Lord Normanby before quitting his former government of Queensland (see above, p. 2).

Mr. Sclater exhibited a drawing of a supposed new Rhinoceros from the Terai of Bhootan, which had been forwarded to him from Calcutta by Mr. William Jamrach, and read extracts from a letter addressed to him by Mr. Jamrach on the subject. Mr. Jamrach, at the date of his letter (Jan. 16th), was leaving for England with the animal alive.

Mr. Sclater exhibited a living specimen of the Peguan Tree-Shrew (*Tupaia peguana*), which had been presented to the Society by the Hon. Ashley Eden, Chief Commissioner at Rangoon, British Burmah, and had reached the Gardens on the 8th inst., being, as it was believed, the first specimen of a living *Tupaia* of any species that had reached Europe. In the same cage was a small Squirrel (*Sciurus blanfordi*) of nearly the same size and colour. The general external resemblance between these two animals, structurally so widely diverse, was very remarkable, and almost amounted to mimicry.

The following papers were read :—

1. On a point in the Mechanism of the Bird's Wing. By A. H. GARROD, B.A., F.Z.S., Fellow of St. John's College, Cambridge, Prosector to the Society.

[Received Januáry 25, 1875.]

The beautiful investigations of Borelli, together with those of M. Marey, make it certain that in any organ which is employed as a flapping wing there must be a stiff or rigid anterior margin. In the insect the stout anterior nervure performs this function; in the bird the bones of the arm, forearm, and manus do the same. How, in the latter, this necessary rigidity is developed, considering the presence of the elbow- and wrist-joints, must be, at first sight, a matter of surprise. It depends on a mechanical arrangement by which, when, in the wing, the arm is bent on the forearm, the manus is always similarly bent on the forearm; and when extension of the forearm is made, extension of the manus equally certainly follows. This occurs when all the muscles and tendons are removed, and the ligaments binding the bones together are alone left.

* "*Fennecus caama*," P. Z. S. 1868, p. 520, et Cat. Carn. Mamm. p. 207.

The explanation of this mechanism is not difficult. The arm consists of one bone only, the humerus; the forearm of two, the ulna and radius; the manus of the two carpals together with the metacarpals and phalanges. The mutual relations of these two bones are such that the radius and ulna move one above the other like the two limbs of a pair of drawing-parallels, each being fixed proximally to the humerus and distally to the carpus. The plane common to the radius and ulna is the same as that in which flexion and extension of the elbow is performed, so that one of the two bones of the forearm, the radius, articulates with the humerus at a point nearer the shoulder, or further from the elbow, than its companion, the ulna. At the wrist the radius is consequently superior, articulating with the carpal bone on the pollex side; whilst the ulna articulates with the other element of the carpus. This condition maintaining the parallel movements of the radius on the ulna must necessarily be attended by a parallel movement of the humerus on the manus. When the humerus bends upon the ulna, the manus therefore similarly bends upon the forearm; and the triceps muscle is able, unassisted, to maintain the whole limb in a rigid state during extension.

In making a wooden model of these bones to illustrate the above described mechanism, one or two points of mechanical detail suggested a reference to the shape of the distal end of the humerus. The wing in the living bird, when at rest, is completely folded; and when fully extended forms but a slightly angular rod. To allow of this considerable range of movement of the bones of the forearm on the humerus, and of their being completely folded up, it is necessary to attach a very projecting hinge at the portion of the model of the humerus which represents the humero-ulnar articulation, otherwise, when fully flexed, the model radius would not be able to be included between the then parallel humerus and ulna; especially as the radius, to get in its fully flexed position, must rotate on a hinge which itself projects its semidiameter at least beyond the humerus.

These requirements explain the characteristic shape of the distal end of the humerus in birds. It is curved towards its flexor side, and sharply so at its extremity where it comes in contact with the ulna. At the same time the radius articulates with it on a well-developed knob, situated above the similar surface for the ulna, and to its outer side (which allows of a less extensive joint). The similar arrangement required at the wrist-joint is arrived at by the interpolation of the carpal bones between the forearm and consolidated metacarpus.

In some wings, when all the muscles are removed, this movement is not so manifest as in others, there being a certain amount of independent power of movement in the manus in all positions. This is much reduced in the living bird by the tendon of the *tensor patagii longus* muscle, which runs from the shoulder, along the free margin of the patagium, to the wrist, where, in being attached to the metacarpal mass on the pollex side, it aids the extension of the manus during the extension of the forearm.

The mechanism above described is stated by Dr. Alix* to have been first indicated by Bergmann, as far as the anatomical arrangement is concerned, although Strauss-Dürckheim, in his 'Théologie de la Nature,' was the first to explain it fully. Dr. Alix himself has also† entered into the detail of the movement "of elongation" of the radius, which is well explained in his large work above referred to‡. My object in bringing the subject before the Society is to draw special attention to so important a point, and to illustrate its action by a wooden model, which demonstrates its accuracy in a very striking manner.

It may be here mentioned that the movement of the general plane of the wing during both the up and down stroke, which by Borelli and his followers is ascribed to the elastic yielding of the feathers in birds, and of the wing-membrane in insects, appears to me rather to be dependent on the torsion of the bones or main nervure of the wing, the power of lateral flexion in which is proved by M. Marey's discovery of the figure-of-8 action in the insect. A thin wooden lath employed as a nervure to an artificial wing, if set with its narrow section vertical and fixed to a non-yielding horizontal wing, gives a vertical figure-of-8 when moved up and down, the plane changing exactly as it is described by M. Marey in the insect.

2. Further Remarks on the Cassowaries living in the Society's Gardens, and on other Species of the Genus *Casuarus*.
By P. L. SCLATER, M.A., Ph.D., F.R.S., Secretary to the Society.

[Received January 29, 1875.]

(Plates XVIII.-XX.)

The recent additions to our series of Cassowaries are of great interest, and seem to necessitate some further remarks upon a subject to which I have more than once directed the Society's attention.

On the 27th of May last year, we purchased of Mr. Broughton of the 'Paramatta,' who seldom returns from Sydney without bringing some welcome addition to our collection, a not quite adult Cassowary, which, as I am informed, had been brought to Sydney in the month of April, 1873, by Mr. Godfrey Goodman, Medical Officer of H.M.S. 'Basilisk,' and had lived some eight or nine months in the Botanic Gardens there§. This Cassowary was entered in the register as a Mooruk; and not being at the time aware of its history, I did not pay special attention to it. Later in the summer, having become aware of its

* 'Essai sur l'appareil locomoteur des Oiseaux,' Paris, 1874, p. 230.

† Bulletin de la Société Philomathique, 1864.

‡ Loc. cit. p. 330 et seq.

§ In a letter just received from Dr. G. Bennett he informs me that he has ascertained from Mr. Goodman that this bird was obtained when quite young from the natives at Discovery Bay, in Milne Bay, on the S.E. coast of New Guinea. Several other specimens of the same bird were subsequently brought on board and purchased.





CASUARIUS WESTERMANNI.



J. E. M. J. de V. a. a.

M. J. H. de V. a. a.

CASUARIUS UNIAPPENDICULATUS.

1. Ex in Viv. Soc. Zool. London.

2. Ex in Viv. Soc. Zool. Rotterdam.

origin, I made a careful examination of the specimen in company with the Superintendent, and at once decided that it was not a Mooruk (*Casuarinus bennetti*), although closely allied to that species in form and structure. It, in fact, more nearly resembles Westerman's Cassowary (*C. westermanni*, mihi, P. Z. S. 1874, p. 248*), but is very differently coloured in the naked parts of the throat, as will be seen by the drawings which I now exhibit.

In *C. westermanni* (Plate XIX.) the throat is blue and the hinder part of the neck deep orange-red. In the new species, which I propose to call *C. picticollis* (Plate XVIII.) the middle of the throat is red, and the hinder part of the neck bright blue. There are, besides, minor differences, which will be evident on comparing the two drawings. Now, so far as I know, these colours in the naked parts of the Cassowaries are quite constant; and I can hardly doubt therefore that we have here to deal with different species. In *C. bennetti*, of which several specimens have lived in our Gardens, the whole throat and hind neck are alike blue. The three non-carunculated Cassowaries known to me may therefore be diagnosed as follows:—

1. *C. bennetti*: gula et cervice postica cæruleis.
2. *C. westermanni*: gula cærulea, cervice postica rubra.
3. *C. picticollis*: gula rubra, cervice postica cærulea.

In order to settle, if possible, the question whether *C. papuanus* of Rosenberg (a fourth described species of this section) is really different from *C. westermanni*, I requested Mr. Smit, when he visited Leyden in August last, to bring me a coloured figure of the head and neck of the typical specimen of that species in the Leyden Museum. I now exhibit Mr. Smit's drawing, from which it would seem that, although it is quite evident that the two species are very nearly related, unless the naked parts have been wrongly coloured in the stuffed specimen, *C. papuanus* may be, as politely suggested by Schlegel† “suivant les principes des amateurs d'ornithologie,” different from, although it is certainly very nearly allied to, *C. westermanni*. This may well be the case, if it should turn out, as suggested by Dr. Meyer (Sitz. Akad. Wien, lxix. p. 217), that *C. westermanni* is the Cassowary of the island of Jobie, and *C. papuanus* that of the mainland of North New Guinea. *C. picticollis* comes, as we know, from the extreme south of New Guinea, and *C. bennetti* from New Britain.

Besides *C. picticollis* we have recently received two other important additions to the series of living Cassowaries—namely, a young example of *C. uniappendiculatus*, presented by Capt. Moresby, of H.M.S. ‘Basilisk,’ in August last‡, and a young Australian Cassowary (*C. australis*), just received from the Marquis of Normanby, lately Governor of Queensland.

The former bird, as Dr. Bennett tells me, was obtained by Captain Moresby from the natives at Cornwallis Island, in Torres Straits, but was stated to have been originally brought from the adjacent

* Figured, P. Z. S. 1872, pl. ix., as *C. kaupi*.

† Mus. d. Pays-Bas, Struthioncs, p. 12 (1873).

‡ See P. Z. S. 1874, p. 495.

coast of New Guinea. It is figured in the sketch which I now exhibit (Plate XX. fig. 1).

There is a young example of the same species now living in the Zoological Gardens of Rotterdam, of which I also exhibit a coloured sketch taken by Mr. Smit in August last (see Plate XX. fig. 2).

As regards our specimen of *C. australis*, in its present immature dress it closely resembles the young of *C. galeatus*, of which a young

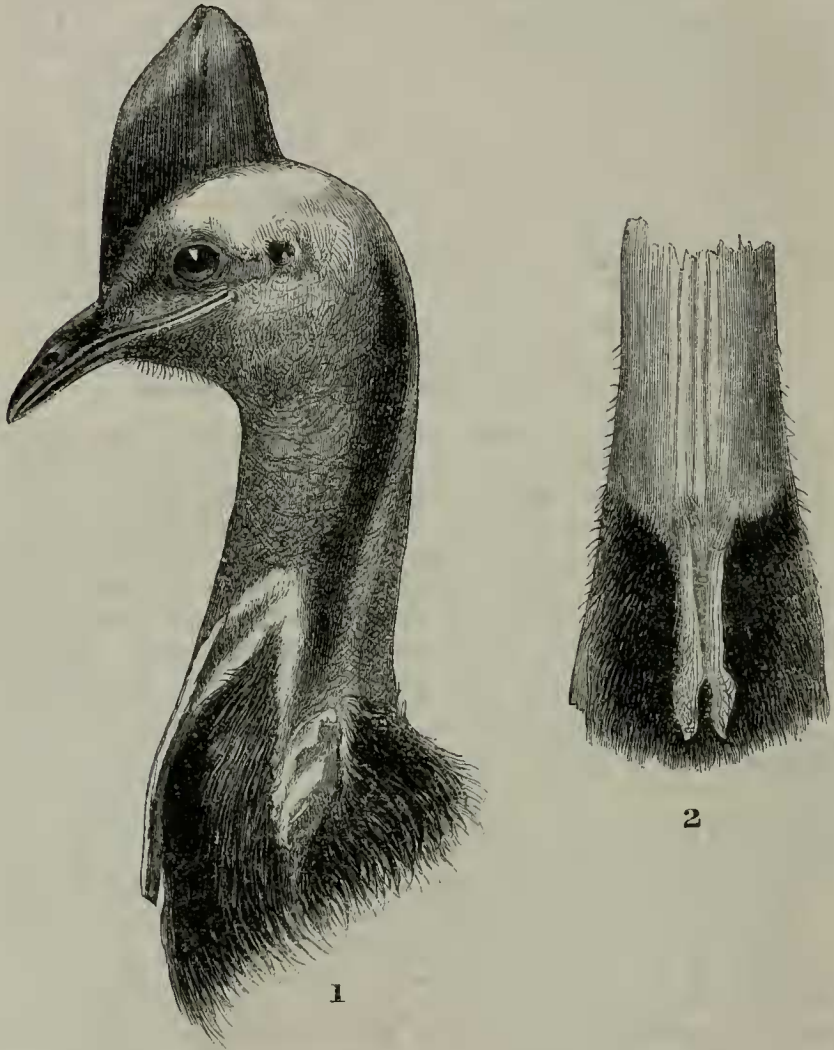


Fig. 1. Side view of head of *Casuarus beccarii*.

Fig. 2. Front view of same, showing wattles.

example has been placed next to it in the Gardens. But it will be observed on comparison that the naked skin on the hind neck of *C. australis* is orange instead of red, and that the legs are more robust.

So much for the Cassowaries now in our Gardens; but I have a

few words to add about a species which we have not yet received, and which appears to be also hitherto unrecognized.

When at Genoa last year the Marquis Doria called my attention to a stuffed Cassowary in the Museo Civico, which had been obtained by Dr. E. Beccari in Wokan, the most northern of the Aroo Islands*. By my friend's kindness I am now able to exhibit coloured sketches of this bird and also of its head and neck (see figures 1 and 2, p. 86). By these it will be seen at once that this species belongs to the section which contains *C. galeatus*, but from the highly elevated crest (see fig. 1) would seem to be more nearly allied to *C. australis*. The neck-wattles, however, are decidedly of a different structure, there being, in fact, only one broad central wattle, which is slightly divided at its termination (see fig. 2). Now the only Cassowary yet known to us from the Aroo Islands is *C. bicarunculatus*†—a very different species. I cannot, therefore, doubt that we have here again to deal with a new species of the genus, which I propose, with the Marquis Doria's sanction, to designate after its discoverer,

CASUARIUS BECCARII, sp. nov.

C. similis C. australi et crista pari modo elevata: sed caruncula cervicis una media, ad apicem divisa.

Hab. Wokan, inss. Aroensium (*Beccari*).

Mus. civit. Genoensis.

The colours of the naked parts of the head and neck, as given in a drawing which M. Doria informs me has been copied from a specimen in spirits in good preservation, would appear to show that in this respect also *C. beccarii* comes nearest to *C. australis*‡.

To conclude, I exhibit a revised table which summarizes our present knowledge of the Cassowaries and their distribution.

Index specierum Generis Casuarii.

a. Casside lateraliter compressa; appendicula cervicis aut duplici aut divisa.

1. *C. galeatus*, ex ins. Ceram.
2. *C. beccarii*, ex ins. Aroensi Wokan.
3. *C. australis*, ex Australia bor.
4. *C. bicarunculatus*, ex inss. Aroensibus.

b. Casside transversim compressa; appendicula cervicis unica.

5. *C. uniappendiculatus*, ex Papua.

c. Casside transversim compressa; appendicula cervicis nulla.

6. *C. papuanus*, ex Papua boreali.
7. *C. westermanni*, ex ins. Papuana Jobie (?).
8. *C. picticollis*, ex Papua meridionali.
9. *C. bennetti*, ex Nov. Britann.

* See Mr. Wallace's Map, Travels in E. I. Arch. ii. p. 219.

† Figured P. Z. S. 1872, pl. xxvi. This specimen (the only adult example known) is now in the Cambridge University Museum, to which it was presented by Lord Walden.

‡ See large figure of the head of this species in Gould's B. Austr. Suppl. pl. 70.

3. Note on a new Locality of *Dinornithidæ*.

By Prof. OWEN, C.B., F.R.S., F.Z.S.

[Received February 1, 1875.]

I have been favoured by an esteemed correspondent, Dr. Cough-trey, with the following notice of a discovery in, to me, a new locality, in the province of Otago, New Zealand, of remains of *Dinornithidæ*. He writes:—"It might, perhaps, interest you to know that we got in the Hamilton Swamp remnants of the following species:—

" *Dinornis maximus*.—— *robustus*.—— *ingens*.—— *struthioides*.—— *rheides*.*Dinornis didiformis*.—— *casuarinus*.—— *crassus*, 2 varieties.—— *elephantopus*, 2 vars.—— *gravis*.

"Of all the above species we have duplicate leg-bones. Besides, we have almost complete skeletons of '*Cnemidornis calcitrans*.'"

It is satisfactory to find that the authorities in charge of the rapidly rising museum of Otago appear to have no difficulty in distinguishing the remains of *Dinornis gravis* from the varieties referable to *Dinornis crassus*, my chief difficulty and, for some time, doubt having been in relation to the limb-bone characters of the former species. Its cranial characters, however, were decisive; and as the number of skulls of *Dinornithidæ* now on hand corresponds with the species, or established varieties, of *Dinornis*, based on characters of the previously found leg-bones, and as the descriptions and figures of these bones in the 'Transactions of the Zoological Society' evidently serve their purpose in aid of the recognition of parts of the skeleton by their discoveries in new localities of New Zealand, one aim of the series of "Memoirs" which the Society has favoured me by publishing has been attained.

4. On *Anomalurus*, its Structure and Position.

By EDWARD R. ALSTON, F.Z.S.

[Received February 1, 1875.]

(Plate XXI.)

This genus was established by Mr. Waterhouse in 1842*, and now contains four or five species, all natives of Tropical Western Africa. In external appearance the Anomalures very closely resemble the larger Flying Squirrels (*Pteromys*)—their most striking outward distinctions being the double series of large salient scales on the lower surface of the first third of the tail, and the fact that the cartilage which serves to extend the flying expansion has its origin at the elbow instead of at the wrist. They are also described as

* P. Z. S. 1842, p. 124.



having similar habits, climbing lofty trees, and passing by a great sailing bound from the summit to another stem; in ascending a tree the caudal scales are pressed against the trunk and thus serve as "climbing-irons." But Mr. Waterhouse pointed out, in his original description, that the genus differs not only from the Flying Squirrels, but from all the other *Sciuridæ*, in many important characters of the skull and dentition—notably in the large size of the infraorbital opening, the almost entire absence of postorbital processes, the contraction and emargination of the bony palate, and the number and appearance of the grinding-teeth.

Since its discovery, zoologists have held very various views as to the true affinities of the Anomalure. Mr. Waterhouse regarded it as an aberrant Squirrel, showing an approach to the Dormice*. Dr. Gray took the same view, placing it at the head of the *Sciurina*, immediately following the *Myoxina*†. Temminck treated *Anomalurus* as a subgenus of *Pteromys*, and first gave some account of the skeleton‡, which was more fully described by Gervais§, and figured in the posthumous part of De Blainville's 'Ostéographie'¶. According to the views which M. Gervais then held, the subfamily *Anomalurina* had no real relationship to the Squirrels, but should be ranked among the *Hystriidæ*, next to *Capromyna*—an arrangement to which Giebel¶¶ and Burmeister** gave their adherence. Brandt first placed the Anomalures as the third tribe of his family *Sciuroides*, under the name of *Anomaluri* seu *Pteromyoxosciuri*, as indicating their relationship††, but subsequently proposed another classification, in which they formed the first subfamily, named *Anomalurini* seu *Sciuri Lemuriformes*, as showing an approach to the Lemurs, through *Galeopithecus*, in the structure of their toes and claws‡‡. M. Gervais has since withdrawn from his first position as to the hystriine affinities of the animal, but, still holding that it is not a Squirrel, unites it with the Dormice and the miocene genera *Theridomys* and *Archæomys* in his "famille des Myoxidés"§§. In this he has been followed by Dr. Fitzinger|||. Prof. Lilljeborg placed *Anomalurina* as a subfamily of *Sciuridæ* showing an approach to the Hystricomorpha of Brandt¶¶¶; and more recently he retains this arrangement, but suggests that the form should probably rank as a distinct family***. This last view is shared by Dr. Gill, who makes the *Anomaluridæ* a family equal in value to the *Sciuridæ*, and places it between the latter and the *Haploodontidæ*†††.

* Ann. & Mag. Nat. Hist. x. p. 202 (1842).

† List Mamm. Brit. Mus. p. 133 (1843).

‡ Esquisses Zoologiques, pp. 143–146 (1853).

§ Ann. Scien. Nat. (3^e sér.) xx. pp. 238–246, pl. xiii. (1853).

¶ Atlas, iv. *Sciurus*, pl. i. (1855). ¶¶ Allgemeine Zoologie, p. 485 (1854).

** Thiere Braziiliens, Th. i. p. 341 (1854).

†† Mém. de l'Ac. St. Pétersb. (6^e sér.), Sc. Nat. vii. pp. 298, 299 (1855).

‡‡ Compt. Rend. Ac. Scien. xliii. pp. 139–143 (1856).

§§ Zoologie et Paléontologie Françaises (2^e ed.) pp. 27–30 (1859).

|| Sitzungsber. Ak. Wissensch. Wien, lv. (erste Abth.) p. 511 (1867).

¶¶ Syst. Öfvr. de Gnagande Däggdjuren, pp. 38, 40 (1866).

*** Sveriges och Norges Rygggradsdjur, i. p. 383 (1874).

††† Smithsonian Miscellaneous Collections, xi. p. 21 (1874).

Through the kindness of Professor Flower and Dr. Günther, I have been enabled to examine specimens of two species of *Anomalure* preserved in spirits in the Museum of the Royal College of Surgeons and the British Museum, and have hence been led to reconsider the question of the nature and affinities of the animal. I have to acknowledge the kind help of my friend Mr. Garrod in the examination and comparison of the very remarkable viscera, which do not appear to have been previously described.

STRUCTURE.

External characters.—With regard to these little can be added to Mr. Waterhouse's excellent original description. On examining specimens in spirits, however, one peculiarity is observed which is less striking in dry skins. This is the arrangement and form of the tubercles on the naked soles of the feet. The fore feet have a series of *five* tubercles at the base of the toes (in *A. pelii* the second inner tubercle is nearly divided in two); behind these there is a small round isolated one in the centre of the sole, and on each side a

Fig. 1.



a. Fore foot, *b.* Hind foot, of *Anomalurus fraseri*, natural size.

larger callosity. In the hind feet there is a series of *six* at the base of the toes, with a small central, one long internal, and two external tubercles. This remarkable arrangement, which is very similar in all the species, is well shown in the figure. The number of scales in the caudal series varies slightly in different individuals. As already noticed, the cartilage, or chondrified fascia, which supports the flying expansion or *patagium*, is attached to the olecranon instead

of to the carpus, although the membrane itself springs from the side of the wrist*. Thus instead of extending along the free front margin of the patagium as in *Pteromys* and *Sciuropterus*, it passes diagonally between its folds to the anterior corner. In the one arrangement the cartilage may be compared to the yard of a lug-sail, in the second to the gaff of a sprit-sail.

Skeleton.—The skeleton of Pel's Anomalure having been described and figured by Gervais and De Blainville, it will be sufficient to remark on the points which bear more especially on the affinities of the animal.

The skulls of *A. fraseri*, *A. pelii*, and *A. beecrofti* are very much alike, though the examination of a series of each would probably show constant specific characters. On comparing the skull of *A. pelii* with that of *Pteromys nitidus*, the differences already alluded to are very striking. The postorbital processes of the frontals are rudimentary and almost obsolete in the Anomalure, while they are largely developed in the Flying Squirrel; on this point, however, too much weight should not be laid; for in the African Ground-Squirrels (*Xerus*) and the Chipmunks (*Tamias*) these processes are comparatively small. The other distinctions are all connected with the function of mastication. The infraorbital foramen is expanded into a large suboval opening in the anterior root of the zygoma, and evidently gives passage to a portion of the masseter muscle, as well as to the infraorbital branch of the fifth pair of nerves, instead of transmitting the nerve only as in *Pteromys* and the other *Sciuridæ*. The glenoid cavity is narrower, the articular surface of the condyle of the mandible is more sloped outwards; and the bony palate is much contracted, convex, and deeply emarginate behind.

In all other essential characters the skulls appear to me to agree. The nasals are narrower in the Anomalure (as they also are in *Xerus*), but of the same general form. The frontals are not more contracted (if the postorbital processes be disregarded), and have the same median depression. The direction of the temporal ridges is the same, as are the position of the foramina of the base of the skull, and the size of the incisive foramina. The structure of the auditory bullæ is identical, their interiors being partially divided into cells by imperfect bony septa, radiating from the walls towards the cochlea: the external meatus is large in both; but in the Anomalure its margin is less produced†. The form and proportions of the mandible are the same in both animals.

The other parts of the skeleton of the Anomalure differ in no important point from that of the Flying Squirrel, except the number of ribs, of which there are sixteen pairs instead of twelve, and the flattening and breadth of the olecranon, to give attachment to the cartilage of the flying expansion. The vertebræ of *A. pelii* are:—

* Temminck was therefore mistaken in stating that the forearm is free in the Anomalure (Esquiss. Zool. p. 145).

† Since the above was written, my friend Mr. A. Doran has called my attention to the auditory ossicles of *Anomalurus*, which are identical in type with those of the true Squirrels.

cervical 7, dorsal 16, lumbar 9, sacral 4, caudal 28; the latter are much elongated. The posterior ridge of the scapula is very salient; and the humerus has a moderate deltoid ridge. The femur has a crest representing the third trochanter; and the slender fibula is quite distinct from the tibia; in *Pteromys* these bones are often closely united below, though not truly fused.

Dentition.—The grinding-teeth of the Anomalure are four in number on each side above and below, the small anterior premolar of *Pteromys* being absent; this tooth, however, is lost early in life in many species of Squirrel. Their series converge in front; and they are placed obliquely; so that the crowns of the upper teeth look outwards, and those of the lower jaw inwards. These crowns are worn perfectly flat even in young individuals, exposing islands of cement separated by cross folds of enamel, which are more directly transverse and less twisted than in the more complicated teeth of *Pteromys*. In the typical skull of *A. beecrofti*, in the British Museum, the cemental spaces are smaller and more isolated than in the other species.

Viscera.—These, like the masticatory apparatus, differ much from those of the *Sciuridæ*, and, indeed, present peculiarities not met with in any other family of the order.

Fig. 2.



Cæcum of *A. fraseri*, natural size.

The tongue resembles that of the Squirrels, but is narrower and more pointed. The circumvallate papillæ are two in number, and are placed transversely.

The œsophagus has a short abdominal course after passing through the diaphragm, extending in *A. fraseri* to about half an inch; its epithelium is not continued beyond the cardiac orifice.

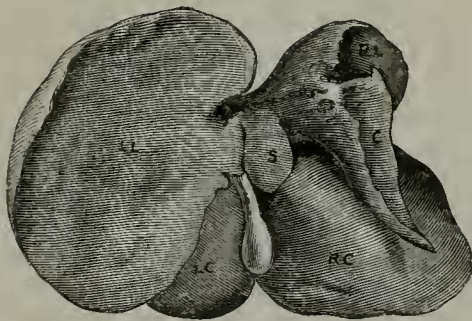
The stomach is perfectly simple and nearly oval, the cardiac and pyloric openings being near one another. The walls are very thin; and the epithelial lining is smooth and perfectly uniform throughout. A very small external fold or pucker runs transversely across the lesser curvature. In *A. fraseri* the greatest diameter is 1·75 inch, the lesser about ·80.

The duodenum has the usual dilatation below the pylorus; the length of the small intestine in *A. fraseri* is 43·50 inches, and in *A. pelii* 60 inches.

The cæcum is of considerable volume. In *A. fraseri* its length is about 5 inches, and its greatest diameter ·50; in the specimen examined of *A. pelii* its proportions were similar, but it was too greatly injured by shot to allow of exact measurement. In form and structure it is very different from that of the Squirrels, and, indeed, from that of any of the *Glires Simplicidentati* with which I am acquainted. It is at first continuous with the colon, irregularly coiled on itself, and sacculated almost to its end by an internal spiral fold, with a free inner edge, as in the Hares; this fold is nearly regular and continuous, but here and there it is interrupted. The extremity is very narrow, perfectly simple, and abruptly reflected on itself. In the figure the cæcum is shown uncoiled and extended, in which condition its structure is more plainly shown than when it is in its natural convolutions.

The colon is at first marked by the inner fold continued from the cæcum; its first loop after leaving the latter is longer than the second. The length of the large intestine from cæcum to anus is in *A. fraseri* about 16 inches, in *A. pelii* 47 inches, making the whole length of the intestine about 60 inches in the former and 107 inches in the latter, or rather more than *five* times the length of the head and body in each case.

Fig. 3.



Liver of *A. fraseri*, natural size.

LL, left lateral lobe; LC, left central; RL, right lateral; RC, right central;
S, Spigelian; C, caudate lobe.

The spleen is of the same shape as in the Squirrels.

The liver has the general proportions shown in the figure. The caudate lobe is long and pointed; it is proportionally smaller in *A. pelii* than in *A. fraseri*. The Spigelian lobe is small and simple, not double or bifid as in almost all known rodents. There is no trace of a cystic notch; and the gall-bladder lies directly over the umbilical fissure—an arrangement which has never been observed, as far as I know, in any other member of the order.

The uterus of the female is long and double. In the male the penis is stated by Gervais to be provided with a bone.

SYSTEMATIC POSITION.

From the above facts it appears to be clear that the *Anomalure* is an aberrant Squirrel, with no special affinities to any other family, that its peculiarities are all purely adaptive, and that they are all in direct connexion with the functions of mastication and digestion.

Thus, in the skull, if we pass the minor point of the reduction of the postorbital processes, we find that it is built on the true sciurine type, *except* in those parts which are modified by the peculiarities of the masseter muscle and teeth. Mr. Waterhouse, with his usual acumen, remarked in his original description:—"The masticating surfaces of these teeth are worn flat by usage, even in the comparatively young animal, as in other rodents which have a large ant-orbital opening, and have not a tubercular surface such as we find in the molars of the typical Squirrels. These last-mentioned animals, it would appear, have a rotatory motion of the lower jaw, while the *Anomaluri* have a longitudinal, no doubt combined with the rotatory motion; and this difference is perhaps due to the action of that portion of the masseter muscle which passes through the antorbital opening" (*l. c.* p. 127)*. The rest of the skeleton, save in the number of ribs, seems also to be that of a true Squirrel; and though the viscera are widely different from those of that group, yet they are also unlike the organs of any other family.

The resemblances which have been pointed out to the Dormice and to the hystricine rodents appear to me to be merely superficial and adaptive. Those to the *Myoxidæ* are only in the size (not the form) of the infraorbital opening, and the number and general appearance of the grinding-teeth, and do not extend to any more important characters. The points of similarity to some of the *Hystricidæ*, in the form of the infraorbital opening, the shape of the bony palate, and the number of ribs, are much more striking, but are at once negatived by the structure of other parts, notably by that of the mandible, zygoma, auditory bullæ, and base of the skull. The teeth, which M. Gervais compares to those of *Cercomys*, have not so great a resemblance to the teeth of any of the *Hystricidæ* as the dentition of the Beaver has to that of the widely distinct Coypu. Brandt's comparison of *Anomalurus* to

* Cf. Von Teutleben, Archiv f. Naturgeschichte, 1874, pp. 91-93.

Galeopithecus, founded on the compression of the toes and claws, seems too fanciful to require discussion, though by a curious coincidence the cæca of the two animals are somewhat similar in appearance.

What may have been the causes of the wonderful modification of the alimentary system and the subsidiary parts of the skull in *Anomalurus* is more doubtful. The facts seem to point to the effect of a more dry and innutritious diet. Beyond Temminck's statement that "ils se nourrissent de fruits," nothing has been recorded of the food of the *Anomalures*; and the contents of the stomachs of the specimens I have examined were unfortunately too well digested to yield much information. That of *A. pelii*, however, contained a quantity of long vegetable fibres, which seems not unfavourable to the idea that they may live principally either on dry and stringy fruit or on leaves.

A further question, and one perhaps incapable of a satisfactory solution, remains. Is *Anomalurus* more closely allied to *Pteromys* and *Sciuropterus* than to the non-volant genera of the family? or are their resemblances an instance of the independent origin of similar structures? The development of a flying-expansion in itself naturally points to the former view, while the remarkable difference in the attachment and course of its expanding cartilage seems to be in favour of the latter.

The geographical distribution of the two groups is worthy of note. As far as we know at present, the *Anomalures* appear to be confined to a limited region of West Africa, extending from the equator to about 15° north latitude, whereas no species either of *Pteromys* or *Sciuropterus* seems ever to have been met with in any part of the Æthiopian region.

If the above views are correct the systematic position of the *Anomalures* is settled, and their rank will merely depend on the higher or lower value given to the whole sciurine group of rodents. If the latter is regarded as a family, then the *Anomalurinae* will be a subfamily of *Sciuridae*; if as a separate section of the order, the *Anomaluridae* will form one of the constituent families of the *Sciuromorpha*. In either case the characters will be the same as those proposed by Mr. Waterhouse for the only known genus.

I now conclude with the synonymy, characters, and habitats of the known species of the genus.

SPECIES.

1. ANOMALURUS FRASERI.

1842. *Anomalurus fraseri*, Waterhouse, P. Z. S. 1842, p. 124; Ann. & Mag. Nat. Hist. x. p. 201.

1842. *Pteromys derbianus*, Gray, Ann. & Mag. Nat. Hist. x. p. 262.

1843. *Anomulurus derbianus*, Gray, List Mamm. Brit. Mus. p. 133.

1860. *Anomalurus beldeni*, Du Chaillu, Proc. Boston Soc. Nat. Hist. vii. p. 303*.

Above grizzled sooty brown, extremities darker, area round ears blackish. Below dirty white, chin and throat dark grey. Measurements of a small specimen in the flesh :—head and body 11 in., tail 11·50, ear 1·30, fore foot (without claw) 1·40, hind foot 2.

Hab. Fernando Po (*Fraser, Brit. Mus.*); Gambia? (*Brit. Mus.*); Ashantee (*Mus. R. Coll. Surg.*).

2. ANOMALURUS PELII.

1845. *Anomalurus pelii*, Temminck, Verhand. over de Nat. Geschied. der Nederl. Bezitt. i. (d. ii.) p. 108; Esquisses Zool. (1853), p. 146.

Above sooty black; the broad margin of the flying-expansion, nose, long hairs at base of ears, tail, and lower parts white; feet white, mixed with dusky. Measurements of a specimen in the flesh :—head and body 17 in., tail 17·75, ear 1·75, fore foot 1·60, hind foot 2·50.

Hab. Fantee, Ashantee (*Pel, Leyden Mus.*; *Brit. Mus.*).

3. ANOMALURUS BEECROFTI.

1852. *Anomalurus beecrofti*, Fraser, P. Z. S. 1852, p. 17, pl. xxxii.

Above grizzled yellowish grey, washed along the spine with rufous; front part of flying-expansion dusky; a short pale band on each side of the neck, and a small white spot between the ears; tail dusky brown. Below bright rufous. Measurements of a dry skin :—head and body 15 in., tail 9.

Hab. Ashantee (*Fraser, Brit. Mus.*); Cameroon Mountains, 7000 feet above sea (*Burton, Brit. Mus.*)†.

4. ? ANOMALURUS LANIGER.

1853. *Anomalurus laniger*, Temminck, Esquisses Zoologiques, p. 149.

Above grizzled grey, washed along the spine and on the shoulders with rufous; tail brown. Throat and breast rufous, rest of the lower parts reddish white. Fur throughout short, thick, woolly, and crisp. Measurements of a dry skin :—head and body 9 in., tail 7.

Hab. West Africa, exact locality not known (*Leyden Mus.*).

I have not seen Temminck's type, which is described as not fully grown and in bad condition. Probably it is the young of the last species, in which the fur is certainly shorter and more woolly than in the others.

5. ANOMALURUS FULGENS. (Plate XXI.)

1867. *Anomalurus fulgens*, Gray, Ann. & Mag. Nat. Hist. (4th ser.), iii. p. 469. 467.

Nearly uniform bright rufous, rather paler below, and passing to

* Cf. Gray, P. Z. S. 1861, p. 275.

† Cf. P. Z. S. 1862, p. 180.

whitish on the sides of the abdomen; a small white spot between the ears. Measurements of a dried skin:—head and body 14 in., tail 7.

Hab. Gaboon (*Brit. Mus.*).

As far as I am aware, the type specimen of this very handsome species is still the only one which has been brought to Europe; and as it has not hitherto been figured, I have chosen it as the subject of the accompanying plate.

5. Notes on the Nest and Egg of *Hypolais caligata* and on the Egg of *Charadrius asiaticus*, Pall., together with Remarks on the latter Species and *Charadrius veredus*, Gould. By H. E. DRESSER, F.Z.S. &c.

[Received February 1, 1875.]

A few meetings ago I exhibited the nest and eggs of *Hypolais rama*, together with the eggs of all known European species of *Hypolais* excepting *H. caligata*, which I then said I expected would closely resemble those of *H. rama**. Since then I have received, through Mr. Wilhelm Schlüter, of Halle, a nest and egg, together with the bird, of *Hypolais caligata*, collected by a correspondent of his in the Kirghis steppes. These I have now the pleasure to exhibit; and it will be seen that both nest and egg differ not a little from those of *Hypolais rama*, collected by Mr. Blanford in Persia. The egg, compared with those of that species, bears about the same affinity as the egg of *H. polyglotta* does to that of *H. pallida*, Ehr. (*H. elatica*, auctt.), being smaller and more pink in general hue, being of a delicate very pale pinkish white colour, sparingly dotted and marked with black and to a slight extent with dark purplish underlying shell-markings. In size the single egg I possess measures 0·6 by 9·475 inch; and, like those of *H. polyglotta*, it is rather stout in form and scarcely so elongated as the eggs of *H. rama*. The nest is a much stouter and more compact structure than that of *H. rama*, and not so deep in the cup. It is carefully built of stems of plants, grass-bents, and fine roots, and is carefully lined with finer bents and a few hairs. The skin sent with the nest and egg agrees closely with a specimen from the Ural, which I compared, and which agreed with the type specimen sent to me from Berlin for examination, as also with examples sent to me from India labelled *Jerdonia agricolensis* and *Phyllopneuste agricolensis* by Mr. W. E. Brooks.

Amongst other specimens received with the above, through Mr. Schlüter, from the Kirghis steppes, are two skins, male and female, in full breeding-plumage, of *Charadrius asiaticus*, Pall., together with an egg of that species, which latter is especially interesting, because the egg of that rare wader appears, so far as I can gather, to have been hitherto unknown.

This egg, which I now exhibit, somewhat resembles those of *Eu-*

* See P. Z. S. 1874, p. 655.

dromias morinellus, but is darker and rather more green in tinge of ground-colour than the general run of those eggs, besides being much less spotted and more oval in shape. It is, as will be seen, warm buff, with the faintest greenish tinge, and sparingly spotted with black, the markings being comparatively small and not large blotches as in those of *E. morinellus*. In size it measures 1.25 by 1.075 inch, and is oval in shape, very slightly tapering towards one end.

It is especially interesting to obtain not only the egg of this species but the bird itself from the locality whence it was originally described. It will be recollected that in 'The Ibis' for 1870, p. 201, Mr. Harting gave a full account of this species and of its close ally *Charadrius veredus*, Gould; and in 1872 (*Ibis*, 1872, p. 144) Dr. Otto Finsch published some notes on these two species, in which he sought to show that the bird referred to by Mr. Harting under the name of *Eudromias asiaticus* should stand as *C. damarensis*, and that his *E. veredus* is the true *C. asiaticus* of Pallas. These specimens, however, which I now exhibit, tend to prove that Mr. Harting was quite right in his identification of Pallas's *C. asiaticus*; but all the distinctive characters of the two species as given by him (*Ibis*, 1870, p. 212) do not always hold good. For instance he states that all the primaries of *C. asiaticus* have the shafts mesially white. This is certainly the case in some specimens I possess, and also in the female obtained from the Kirghis steppes; but the male has the shaft of the first primary only white, almost all the rest being as dark as the web of the feather.

The best distinctive character besides measurements is the colour of the axillaries, which in *C. asiaticus* are invariably white, and in *C. veredus* dark smoke-grey. I cannot but think that there is some mistake in the colour of the tarsus of *C. asiaticus* as given by Mr. Harting, who, both in his description and in the plate, gives it as being *greenish* ochreous. Now Pallas expressly states that the colour of the tarsus is yellowish; and in his plate (*Zoogr. Ross.-As.* ii. pl. 58) he figures the bird with the legs ochreous yellow. I do not know where Mr. Harting obtained the particulars he gives as to the colour of the tarsus being greenish; but it is possible that the description may have been taken from a young bird, and that the young have the tarsus darker than the old birds; or else, as in some other waders, the colour of the tarsus may vary at different seasons of the year.

I observe that Mr. Harting follows Keyserling and Blasius in referring both *C. asiaticus* and *C. veredus* to the genus *Eudromias*; but I have grave doubts as to this being correct. In *Eudromias* (the type of which is *E. morinellus*) the female is more richly coloured than the male, whereas in both the above species the female lacks the rich nuptial dress of the male and is not unlike its mate in winter dress. Professor Newton has pointed out to me that the sternum of *E. morinellus* differs greatly from that of true *Charadrius*; and it will be interesting to ascertain, so soon as a skeleton of either *C. veredus* or *C. asiaticus* can be procured, whether these species assimilate to *Eudromias* or to true *Charadrius* in that respect. Meanwhile I think it advisable to refer them to the latter group.



1.

2.

6. On a Collection of Birds from Labuan. By R. BOWDLER SHARPE, F.L.S., F.Z.S., &c., of the Zoological Department, British Museum.

[Received February 2, 1875.]

(Plate XXII.)

Mr. Hugh Low, well-known for his researches into various branches of Natural History in Borneo, has lately sent over to England a collection of birds, which I have had the pleasure of examining. The locality whence this collection came, Labuan, has been brought prominently under the notice of ornithologists by the little work of Messrs. Motley and Dillwyn, wherein many fine species are figured*. The present consignment of Mr. Low, however, contains many species before unknown to inhabit the island; and it adds more than one species to the Bornean avifauna, on which Count Salvadori has recently written such an excellent work†. The latter has been of the greatest assistance to me in the determination of the species mentioned in the present paper.

Family STRIGIDÆ.

1. *NINOX BORNEENSIS*, Bp.; Salvad. *l. c.* p. 18.

Three specimens sent by Mr. Low are apparently referable to this species, having the same number of tail-bands (four) as a Sarawak skin; but all three of the Labuan birds are of a very dark colour, almost blackish chocolate, and have no perceptible white on the face and throat; in this respect they contrast strongly with the above-mentioned Sarawak bird, which was collected by Mr. Wallace.

Family CAPRIMULGIDÆ.

2. *BATRACHOSTOMUS AURITUS*.

An adult specimen, agreeing in the main with Malaccan examples. This large Goatsucker is not included by Count Salvadori.

3. *BATRACHOSTOMUS JAVENSIS* (Horsf.); Salvad. *l. c.* p. 112.

One example, rather darker and greyer than those examined from other localities, but apparently not specifically distinct.

4. *CAPRIMULGUS SALVADORII*, sp. n. (Plate XXII. fig. 1.)

Blackish: head greyer, very finely vermiculated whitish, with many of the feathers in centre of crown black, others centred with black; hind neck with a few rufous bars, disappearing on interscapular region; wings blackish brown, with a few fulvous vermiculations

* Contributions to the Natural History of Labuan and the adjacent coasts of Borneo. 8vo, London, 1855.

† "Catalogo sistematico degli Uccelli di Borneo con note ed osservazione di G. Doria ed O. Beccari intorno alle specie da essi raccolte nel Rajeato di Sarawak," Ann. Mus. Civico Genoa, vol. iv.

towards the tips of the feathers, which are subterminally barred with fulvous or whitish, the innermost very broadly and plainly barred with sandy buff; scapulars black in the centre, with broad marginal bands of sandy buff; primary coverts and quills blackish, the secondaries vermiculated with sandy buff, the innermost greyish; first four primaries with a large white spot, extending on to both webs in the second, third, and fourth; centre tail-feathers greyish brown, vermiculated with sandy buff and crossed with eight bars of darker brown, the rest of the feathers dull brown, crossed with about eight vermiculated bands of fulvous, none of them very distinct, the two external feathers almost uniform except for a few notches of sandy buff on the outer web, the terminal third being pure white; sides of face rufescent, mottled with dark brown bars, the cheeks whitish, barred with brown and forming an indistinct moustachial stripe; throat rufous, mottled with brown bars, on the lower part a distinct gular patch of white; chest ashy brown, barred with buffy white, all the feathers more or less mottled with fulvous vermiculations; remainder of under surface fulvous, barred with dusky brown; under wing-coverts dark brown, barred across with sandy buff, the lower series uniform blackish like the inner lining of the wing. Total length 9 inches, culmen 0.45, wing 7.0, tail 4.9, tarsus 0.6.

I cannot identify this Goatsucker with any Malayan species, most of which are in the museum. The species given by Count Salvadori are *Caprimulgus affinis*, *C. arundinaceus*, *C. macrurus*, *C. borneensis*, and *C. concretus*; and with none of these does it agree at all.

With regard to *C. borneensis*, described by Mr. Wallace for the first time in Count Salvadori's book, there can scarcely be a doubt that it is the true *C. concretus* of Bonaparte. Mr. Wallace had very probably overlooked the correction of the Ashantee habitat of this bird given in the 'Conspectus' (p. 60), and doubtless did not compare his Bornean bird with the description of an African species. The great peculiarities of *C. borneensis* are the broad transverse white markings on the under surface and the unspotted quills, both of which are mentioned in Bonaparte's description. The large white tail-spots and the four spots on the quills are very prominent characters in *C. salvadorii*. I may add that the types of *C. borneensis* from Banjermassing are in the museum and before me as I write. The figure of *C. concretus* (Plate XXII. fig. 2) is from one of these typical specimens.

Family ALCEDINIDÆ.

5. *CEYX SHARPII*, Salvad. Atti R. Ac. Tor. iv. p. 463; Sharpe, Monogr. Alced. pl. 42; Salvad. Ucc. Born. p. 98.

Count Salvadori points out that the figure of this species in my 'Monograph' is "very inaccurate;" but beyond the difficulty which any one will find in representing the exact brilliancy of a lilac tint by the hands of colourists, I cannot allow the inaccuracy of the plate. The fault lies more with the species, for three specimens of *C. sharpii* occur in the present collection along with *C. dillwynni*, and I feel tolerably certain that Count Salvadori's species will turn out ulti-

mately to be only a stage of the last-named bird. They all possess in a greater or less degree the blue terminal spots to the median wing-coverts, and are generally of a more brilliant shade than the ordinary *C. rufidorsa*; all have, also, red tails and coral-red beaks. One of them has the wing-coverts rufous; but the other two exhibit a tolerable admixture of black. The black line running along the hinder scapulars, so apparent in the typical specimen, exists only in one of the examples; and there it is also so shaded with blue as closely to approach *C. dillwynni*. None of the specimens of *C. sharpii* has the frontal spot, which is plainly marked in all three of *C. dillwynni*.

Having examined the types both of Strickland's *C. rufidorsa* and Salvadori's *C. innominata*, I can affirm that they are absolutely one and the same species; and the latter title must therefore give way.

6. *CEYX DILLWYNNI*, Sharpe, P. Z. S. 1868, p. 591; *id.* Monogr. Alced. pl. 43; Salvad. Ucc. Born. p. 99.

I was delighted to see three more specimens of this previously unique Kingfisher. The type was originally described by me from a Labuan specimen procured by the late Mr. Motley, and apparently was quite adult, judging from the specimens now sent, which have short and brownish beaks. In the main they agree with the description and figure of the type in my 'Monograph;' and all have blackish tails, more or less rufous at the base of the feathers.

7. *ALCEDO MENINTING*, Horsf.; Salvad. Ucc. Born. p. 93.

Alcedo asiatica, Sw.; Sharpe, Monogr. Alced. pl. 5.

The receipt of three specimens in Mr. Low's collection strengthens my opinion expressed in the 'Monograph,' that the Bornean examples of this Kingfisher are not different from those inhabiting other parts of the Indo-Malayan subregion. The only really variable form of *A. meninting* that I am aware of is the bird now called by Lord Walden *Alcedo beavani*. Lord Walden has now seen several specimens, and he may therefore be right in considering *Alcedo beavani* a distinct species; but I should like to compare a series of both before admitting that it is any thing more than a large race of *A. meninting*. A very young bird sent by Mr. Low is very similar to the adult birds, and is even more brilliant cobalt on the back, but differs in the short beak, which is black with an ivory-white tip.

8. *HALCYON PILEATA* (Bodd.); Sharpe, Monogr. Alced. pl. 62.

Entomobia pileata, Salvad. *l. c.* p. 102.

One example known from Sarawak, but not previously met with in Labuan.

Family MEROPIDÆ.

9. *MEROPS BICOLOR*, Bodd.; Salvad. *l. c.* p. 90.

Mr. Low has sent quite a series of this Bee-eater, the adults not presenting any remarkable variation beyond a certain difference in